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AGRICULTURAL Research

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CONTROLLING AIR POLLUTION DAMAGE

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AGRICULTURAL
Research

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Cutting Air Pollution Losses

Last year air pollution caused agriculture an estimated $500 million in losses, and the problem is getting worse.

Farmers no longer raise spinach in some areas of New Jersey because of air pollution. Weather fleck, caused by the air pollutant ozone, cuts yields and quality of shade-grown cigar wrapper tobacco in Connecticut, and Massachusetts, and Florida—the most valuable tobacco grown in this country. Losses in the $25 million crop in Connecticut and Massachusetts have been as high as $5 million per year. Growers have cut losses to some extent by raising resistant varieties, but even these have suffered damage.

Research is underway to combat these losses, and ARS is among the leaders in this research.

Basic studies by ARS scientists have contributed to better understanding of the problem and its causes. Eight years ago, ARS plant scientists identified ozone as the cause of weather fleck in tobacco (AGR. RES., March 1959, p. 8). Their discovery led to greatly expanded studies into possible ozone injury to other vegetation in the East.

The ARS researchers developed Beltsville W–3, a tobacco variety extremely sensitive to ozone. It is now used widely as a biological indicator of the presence of this air pollutant. Recently, the plant scientists discovered that ozone and sulfur dioxide can combine to injure plants before a single air pollutant would cause injury (AGR. RES., Oct. 1966, p. 3).

Now, ARS is expanding its research with the establishment of a new Plant Air Pollution Laboratory at Beltsville. Md. (p. 3 and 4).

In the new laboratory, scientists of various disciplines will work with a broad range of agronomic, horticultural, and ornamental plants. They'll try to learn more about air pollution, the plants it affects, and the ways it affects these plants.

These and other basic studies will lead to the development of more resistant varieties, and of other ways of combatting damage from air pollution.

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New ARS Laboratory Established to

CONTROL AIR POLLUTION DAMAGE

WHEN WEATHER conditions are right—with warm air aloft trapping cooler air at ground level—air pollutants build up near the ground. They damage some plants as well as causing discomfort to humans and animals.

In recent years the problem has become worse, particularly in and near urban areas. There, heavy concentrations of pollutants cut yields and lower the quality of crops, damage tree leaves, and retard the development of ornamental plants.

To learn how best to combat the problem, ARS has established a new Plant Air Pollution Laboratory at Beltsville, Md.

Basic research in the laboratory will be directed toward a better understanding of how air pollutants act on agronomic, horticultural, and ornamental plants; and toward developing methods for controlling damage to plants.

Until now, ARS air pollution research at Beltsville has been limited to the effects of pollutants on tobacco plants. The new laboratory will enable scientists to expand this research to include a broad spectrum of plants—both cultivated and wild.

Initially, the scientists will use oats, alfalfa, petunias, and beans as test plants. These are representative species known to be sensitive to air pollutants. Tobacco plants will serve as standards for comparison.

This expanded research will be

ST-1736-8

Leaf of ozone-sensitive tobacco variety Beltsville W–3 shows white spots characteristic of air pollutant damage, called weather fleck.

ST-1735-8

H. E. Heggestad, who will head new ARS Plant Air Pollution Laboratory, checks graph from meter that measures concentration of ozone in air.

H. E. Heggestad examines plants—oats, petunias, beans, and tobacco—that will be used to study effects of air pollution in new laboratory.

ST–1735–4

closely coordinated with other studies at Beltsville and ARS air pollution research in cooperation with the U.S. Public Health Service at Taft Sanitary Engineering Center, Cincinnati, Ohio.

H. E. Heggestad, ARS plant pathologist and a pioneer in research on air pollution damage to tobacco plants, will head the new laboratory, to be staffed eventually with five scientists of various disciplines.

The scientists will concentrate on air pollutants in photochemical smog, including ozone, pheroxyacetyl nitrate (PAN), sulfur dioxide, and nitrogen oxide. Fuel combustion and auto exhausts produce the major portion of these pollutants.

In their research, the scientists will:

- Characterize pathologic, physiologic, and biochemical changes induced in plants by air pollutants.
- Study the effects of pollutants on plant pigments and stomatal action; on yield and quality of flowers, fruits, and seeds; and their relation to premature development of leaves.
- Identify species and varieties that are resistant or susceptible to air pollutants. Until the level of air pollution can be reduced by prevention at the source, identification and development of resistant plants is probably the best method of controlling damage.
- Further explore the possibility of using chemicals as antioxidants to reduce damage.

Special fumigation chambers in the laboratory will help the scientists better understand what air pollutants do to plants. In these chambers, plants can be exposed to specific levels of pollutants for specific time periods.

The laboratory will also include greenhouses equipped with special carbon filters that will remove most of the air pollutants in photochemical smog from incoming air. Performance of plants grown under filtered air will be compared with plants grown under nonfiltered air.

Carbon filtered greenhouses are now used commercially in some parts of California. Research at Beltsville indicates that they may be necessary along the Eastern Seaboard for growing sensitive plants without serious injury from polluted air. In one test, the ozone sensitive tobacco Beltsville W–3 yielded 93 percent higher in filtered than in nonfiltered air.■

Scientists Identify Substance that

PREVENTS INSECTS FROM MATURING

A SUBSTANCE in the wood of the balsam fir prevents insects from developing into adults. ARS scientists at Beltsville, Md., have isolated and identified the substance—a hormone-like compound called juvabione.

Now, scientists will determine the effects and potential uses of the pure chemical for insect control. They will also determine if juvabione can be synthesized inexpensively. Although a particle smaller than a pinpoint keeps an insect from maturing, substantial quantities of the compound would be needed for use in large-scale field tests.

Scientists at Harvard University first discovered that something in balsam wood prevents an immature Hemipteran bug from becoming an adult. Entomologist W. S. Bowers, and chemist M. J. Thompson, and research assistant E. C. Uebel at the ARS Insect Physiology Pioneering Research Laboratory, working with H. M. Fales of the National Institutes of Health, isolated juvabione and determined its structure.

Juvabione is one of a number of compounds that affect insect growth. A manmade hormone prepared by Bowers and coworkers is even more potent than juvabione (AGR. RES. March 1966, p. 8) and is now being tested for safety.

Unlike this hormone, however, juvabione is found widely in nature. It exists in large quantities in the balsam fir and can be extracted from paper made from balsam wood.

Insects treated with juvabione develop into overgrown nymphs. Then they perish, instead of developing into virile adults.

Scientists first observed the effects of juvabione on insects of the *Pyrrhocoridae* family of the Hemiptera order. That family includes the cotton stainer, a minor pest of cotton and ornamentals in this country but a major cotton pest in South America, Africa, and Asia.

ARS researchers have now successfully used juvabione to stop the development of the box elder bug, a representative of another Hemiptera family; and of the mealworm, an insect of another order and an important pest of stored grain, flour and livestock feed. Thus, scientists believe that juvabione may be effective against many insects of the Hemiptera order, which includes bedbugs and chinch bugs, and of other orders.■

ST–1735–2

Entomologist W. S. Bowers examines the nymph and adult stages of the linden bug. Close-ups of the linden bug below show the insect in the last stage of the nymph phase (left); an overgrown nymph that was treated with juvabione (center); and a normal adult (right). The treated nymph will not develop into an adult.

ST–1736–15

ARS Cooperates in Improving LEGUMES for South Asia

CHICKPEAS, BEANS, and other legumes may alleviate widespread hunger in Iran, India, and other South Asian countries.

But in 10 years, the production of edible legumes (pulses) in South Asia must increase 60 percent to provide even minimal nutrition there.

For economic and religious reasons, meat is not eaten by millions of people in South Asia. Pulses, high-quality food rich in protein, are an important source of nutrients for these people.

Unfortunately, yields in Asian countries are very low. In India, for example, with more than 60 million acres in pulse crops, the per acre yield of chickpeas is 400 to 600 pounds, compared to a potential of about 1,350 pounds. Low yields are caused by inferior seeds, insects and diseases, poor fertilizers, and poor management practices.

ARS scientists cooperating with the Agency for International Development (AID) are helping the people of Iran and India increase the production of pulse crops by breeding higher yielding plants, improving disease and insect control measures, and developing better crop, soil, and water management practices. ARS plant breeder P. H. van Schaik is leader of the regional projects which began two years ago in Iran and last year in India.

Working in Tehran, Iran, are ARS entomologist S. W. Wilson, soil scientist G. M. Horner, plant pathologist W. J. Kaiser, and agronomist K. H. Evans. Working in New Delhi, India, are ARS geneticist R. M. Matsuura, plant pathologist F. J. Williams, soil scientist R. J. Davis, and entomologist K. E. Gibson.

To date, the scientists have increased yields as much as 40 percent over those of local varieties of pulse crops. They have also found dry pea varieties resistant to weevils and chickpea varieties resistant to corn earworms which show promise as breeding stock.

In addition, researchers at Beltsville, Md., have identified herbicides which could be used for weed control in pulse crops.

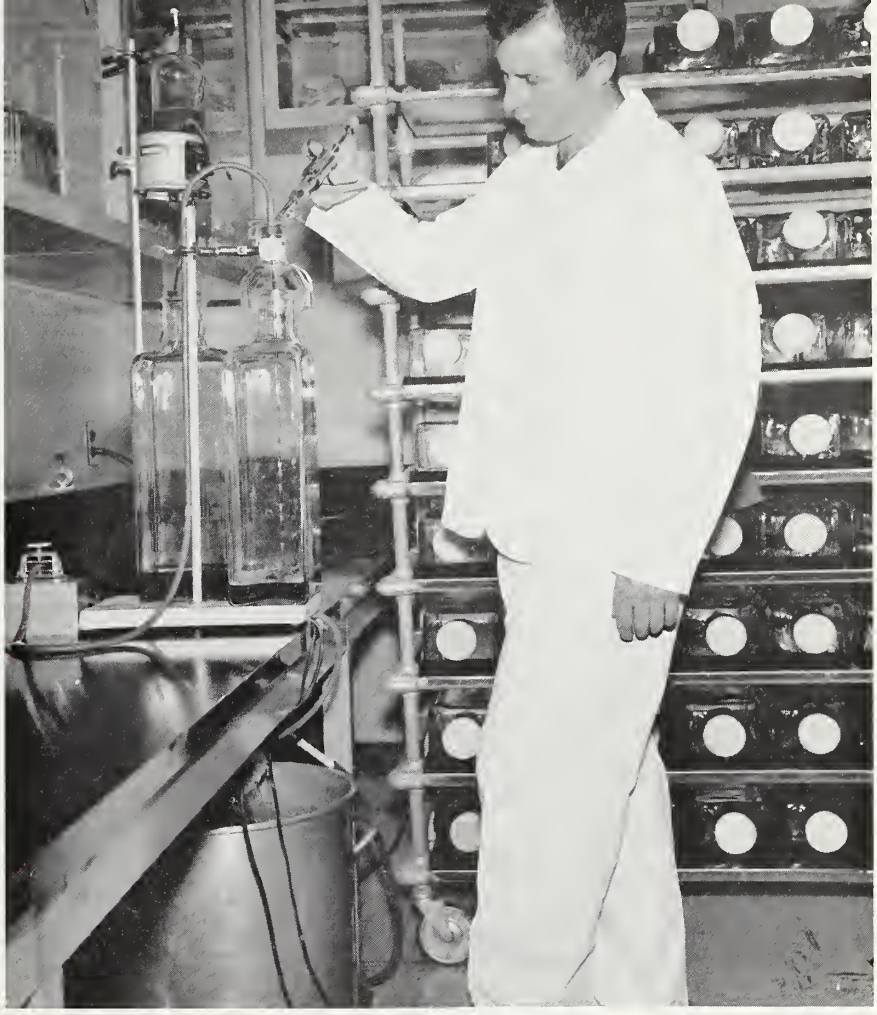
The ARS specialists work closely with native scientists. To develop superior varieties of pulses, they use germ plasm collected from different parts of the world.

Improved seeds are now being tested for suitability at 27 research stations in various parts of India. In Iran, varieties developed through breeding work at the Karaj Agricultural College, near Tehran, are being tested at 11 research stations.■

PN-1452

ARS plant pathologist F. J. Williams (right) and Indian agricultural scientist B. Baldev examine mungbean plants affected by virus disease at the Indian Agricultural Research Institute, New Delhi.

Foot-and-Mouth Disease Test DETECTS TRACE AMOUNTS OF VIRUS



PN–1453

For foot-and-mouth disease virus detection test, technician R. P. Goldsmith injects material suspected of containing virus as tube carries virus growth medium into 5-quart bottle. Offset neck keeps fluids in place when bottle is laid on side in rack during incubation to provide for growth of any virus present.

A TEST CAPABLE of detecting trace amounts of foot-and-mouth disease virus (FMDV) has been developed by an ARS scientist at the Plum Island Disease Laboratory, Greenport, N.Y.

It may prove of value in the preliminary safety testing of certain foot-and-mouth disease vaccines in countries where vaccination is used to protect cloven-hoofed livestock from this costly disease.

Research veterinarian Peter Gailiunas developed the test after he found that tiny quantities of infectious FMDV are able to infect calf kidney cell cultures, even when the virus is suspended in large volumes of fluid.

For the test, a layer of calf kidney cells is grown in a rectangular, 5-quart bottle. Material suspected of containing virus is mixed with 1 or 2 quarts of virus growth medium and placed in the bottle to cover the calf kidney cells.

If any infectious virus is present in the suspected material, it will invade the cells and multiply. After incubation for 48 hours at 98.6 degrees F., it can be easily detected through standardized laboratory tests.

Gailiunas has found that the test is capable of finding live virus that may occur in very small amounts in the blood, organs, or tissues of some animals. Thus, it might be used to screen animal products to make sure they are free of viruses.

The test might also be used in place of animals now used for testing the safety of certain FMD vaccines. However, the virus growth medium and the type of cells used in the test would have to be varied to fit the particular FMD vaccine being tested.■

PN-1454

FOR FARMERS WHO HIRE MIGRANTS — BETTER HOUSING MEANS BETTER WORKERS

A FARMER WHO offers better housing to migratory labor will generally attract better workers.

ARS architects and engineers and U.S. Public Health Service (PHS) researchers reached this conclusion after studying existing conditions and facilities for migrant agricultural workers throughout the country.

Based on their studies and on the experiences of other agencies concerned with housing for migratory labor, the ARS researchers have developed design guides for housing that is economical to build, easy to maintain, and has space and facilities for clean, healthful living.

Providing housing for seasonal migratory farmworkers has long been a serious problem for farmers, especially because of length of occupancy and costly construction standards imposed by some lending agencies.

The ARS–PHS studies show, however, that it costs a farmer less to provide good housing than to try to operate without good help. The farmer who offers good housing has a greater chance of attracting good workers and can be more sure they will stay as long as needed and will return another year.

In developing their guides, the researchers gave particular consideration to standards recommended in 1956 by the President's Committee on Migratory Labor and to standards set up by States. These standards emphasize such things as length of occupancy, number of square feet of floor space per person, water supply, lighting, heating, and facilities for eating, bathing and laundry, and sewage and refuse.

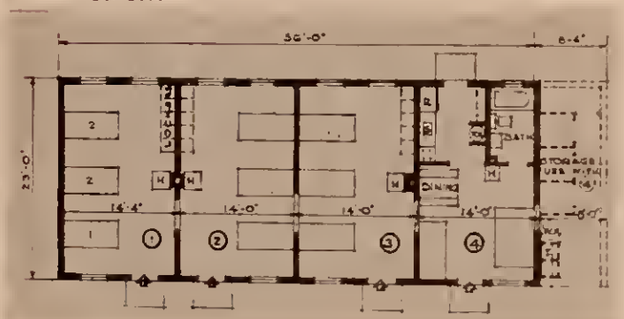
To build and improve housing for domestic farmworkers, qualified farmowners, associations of farmers, State or political subdivisions, and nonprofit organizations can apply for loans from the Farmers Home Administration of USDA. Those who qualify can also get assistance under the Economic Opportunity Act of 1964.

Plan guides for migrant housing are found in Agricultural Information Bulletin No. 296, "Housing for Seasonal Farm Workers," which can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 for 10 cents a copy.

Housing built from these plans should be checked to see that it conforms to local codes or regulations governing construction, heating, plumbing, electrical wiring, fire prevention and sanitation. *There are no complete working drawings available.*

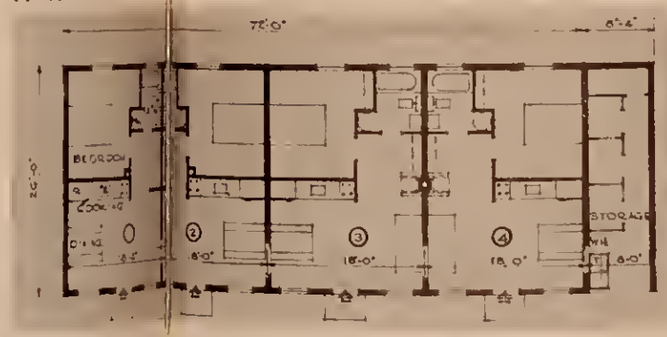
The researchers are now developing other planning guides for construction of family housing for farmworkers.■

PN 1455



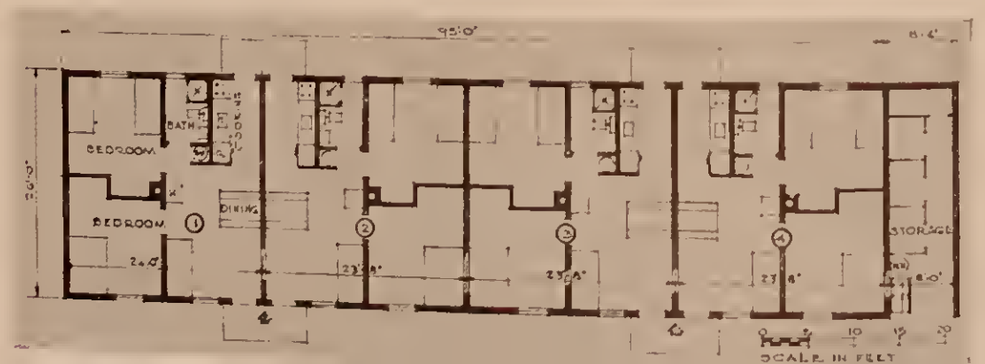
Plan 1: Can be adapted to dormitory-type units with double deck bunks, efficiency apartments with kitchen and bath, or a combination of the two. An apartment could accommodate parents and a child under 10. If the building is used as a dormitory, eating, bathing, and toilet facilities would be centrally located. (See drawing above.)

PN 1456



Plan 2: One-bedroom unit suitable for families with one or two children.

PN 1457



Plan 3: Two-bedroom apartments can accommodate family with two or three children.

WITH WINTER OATS... LOW TEST WEIGHTS DON'T CUT YIELDS

SAVING SEED FROM winter oats for planting the following season is a sound practice even if the seed is low in weight.

Farmers commonly use some of the best grain from a previous oat crop as seed. But spring oats of low seed weight, resulting from unfavorable growing conditions, produce low-weight grain unless environmental conditions are favorable throughout the 3-month growing season.

To determine whether winter oats behave in the same way, agronomists P. G. Rothman of ARS and D. H. Bowman of the Mississippi Department of Agriculture conducted tests at Stoneville, Miss., in cooperation with that Department and the State Experiment Station.

The agronomists planted 8 lots of oats with test weights ranging from 22 to 36 pounds per bushel. They treated part of the seed in each lot with a fungicide used to prevent smut disease. Oats were planted at rates of 2, 3, or 4 bushels per acre.

All lots yielded about the same—regardless of test weight, fungicide treatment, and planting rate. All oats had test weights of about 26 pounds per bushel. Yields of the test lots ranged from 92.2 to 100 bushels per acre, and averaged 95.5 bushels.

Winter oats can make up for low seed weights, the researchers explain, because of their longer (6 to 7 month) growing season. Winter oats also tiller freely, making up for poor stands.■

TREATING APPLE SLICES PREVENTS BROWNING

REFRIGERATED FRESH apple slices will keep their natural flavor, color, and crispness up to 6 weeks if treated by a new method developed by ARS chemists.

With present methods, apple slices stored at temperatures above freezing will keep for about a week before turning brown. At temperatures below freezing, processors can prevent browning for longer periods.

Most apple slices of the type studied are prepared by processors who supply bakers and other food service operators. The new process should help these suppliers to improve their services and may even make possible the direct sale of apple slices to consumers.

Developed at the ARS Western utilization research laboratory in Albany, Calif., the new method is already used commercially on a small scale. Further evaluation will determine whether its use becomes more widespread.

A natural chemical reaction causes untreated apple slices to discolor. Chemical compounds called phenols, which are abundant in fresh apples, turn brown when the untreated slices are exposed to oxygen. A basic finding by ARS biochemist B. J. Finkle led to development of the new process for preventing this chemical reaction. When the apple slices are placed in an alkaline medium, Finkle found, an enzyme present in the apple tissue causes a change in the phenol compounds so that they do not turn brown on exposure to air.

This change—methylation—apparently does not occur naturally because the apple slices are acidic rather than alkaline.

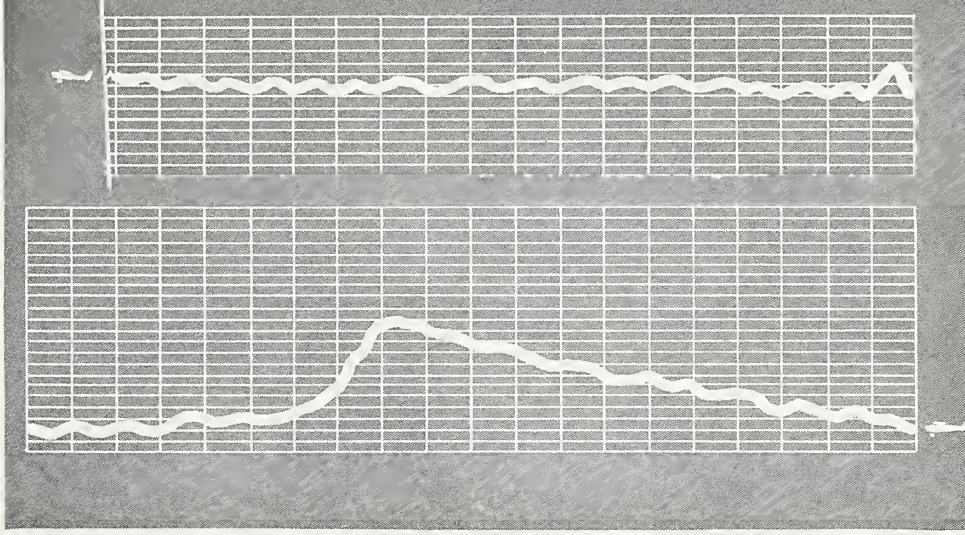
ARS fruit-processing researchers H. R. Bolin and F. S. Nury based their three-step method for treating apple slices on Finkle's studies.

First, the researchers dip freshly cut slices briefly in a bisulfite solution to provide initial protection against color change. Then, they soak the slices in a weak solution of potassium phosphate, which washes off the bisulfite and provides the necessary alkaline medium. Finally, they remove the slices from the solution and package them.

Since the second step causes only a slight change from acidity to alkalinity on the apple's surface, texture, flavor and color are not affected.■

PN-1458

These apple slices, treated and then refrigerated, are crisp, light colored, and fresh flavored.



Charts attached to the plane's instrument panel recorded the fairly straight flight when the plane was radio-guided (top chart) and the 990-foot deviation off course when balloon-guided (lower chart).

Radio Guidance May Mean

GOODBY to the FIRE ANT

RADIO SIGNALS MAY broadcast goodby to the fire ant, a vicious pest of man and livestock.

Radio-guided airplanes treating about 1,350,000 acres near Shreveport, La., are providing faster and more uniform coverage than ARS plant pest control efforts have ever achieved in a major campaign. The treatments confirm promising results of preliminary tests in a smaller area near Alexandria, La. The Louisiana State Department of Agriculture is cooperating in the program.

The fire ant, which came to the United States from South America, threatens larger areas than it now infests because the climate is ideal in most of the South and large parts of the West. The pest is now found in 10 States: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, the Carolinas, Tennessee, and Texas.

The fire ant lives in urban as well as in rural areas. It can severely damage crops, and its mounds, or nests, are hazardous to farm machinery and spoil the appearance of lawns.

Previously, fire ant control workers used balloons to mark courses for spraying. This system required as many as 25 workers. As few as three workers can operate the radio-guidance program, serving several planes simultaneously.

Balloons cannot be used in windy weather, thus valuable time may be lost while the costs of a standby crew mount. Radio-guided planes can operate under windy weather conditions. Except in strong winds, drift is no problem in applying the granular bait. More thorough coverage and longer runs are also possible with the radio-guidance system.

Here's how the system works: Portable radio transmitters at three selected points in the area to be treated broadcast signals. Electronic instruments in the plane pick up the signals and activate a guide needle on the instrument panel. They also automatically mark a chart which shows the pilot his location and intended flight path, plotted in advance.

The charts provide a permanent record of the area actually treated and aid the pilot in alining his next run in a path parallel to the previous run. They also make it possible for planes to make runs up to 30 miles. Previously, planes usually were limited to 10-mile runs and had to make many more runs to cover a given area.

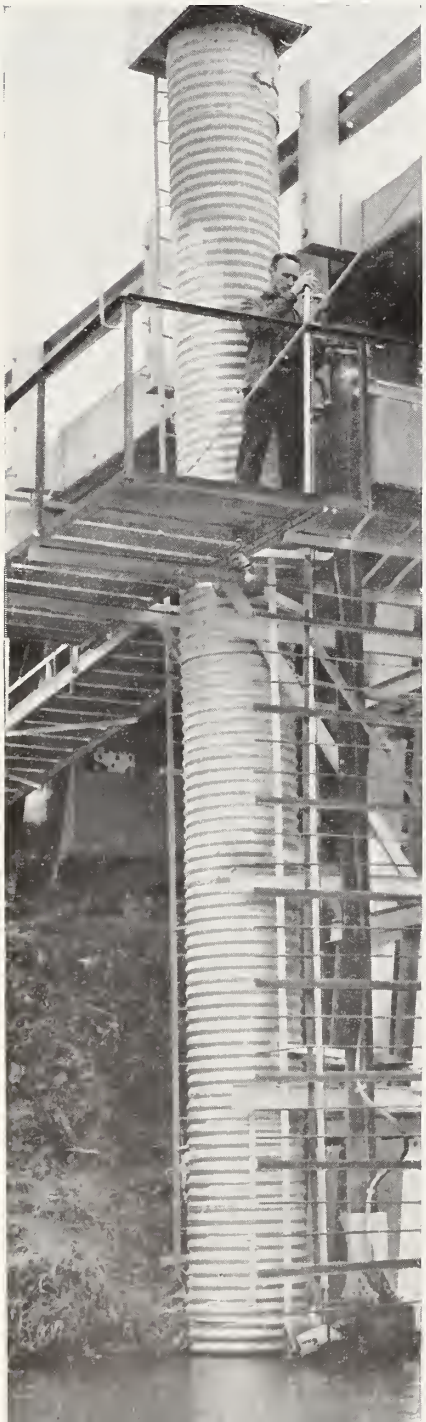
To keep on course, the pilot watches the guide needle which he centers when he determines he's on course at the beginning of each run. He can quickly correct his course if the needle swings to left or right—indicating that the plane is deviating from its course by more than 10 feet.

In one test comparing balloon guidance to the radio-guidance system, the pilot lost sight of the balloon. The radio-guidance system, used as a check, showed that the plane had deviated nearly 1,000 feet off course.

Later, the pilot relocated the balloon and got back on course, leaving an untreated area between balloon guides that would not have been covered if not detected by the test use of the radio-guidance system. Often, 10 percent or more of a treated area has had to be re-sprayed because of such skips.■

NUCLEAR GAGE MEASURES SEDIMENT

PN-1460



A GAGE TESTED by ARS and available commercially uses nuclear energy to measure sediment in streams and rivers and then automatically records data.

Scientists have traditionally measured sediment by taking water samples from streams and weighing the samples in the laboratory. The nuclear gage eliminates such hand labor and provides a continuous report for fast, inexpensive sediment checks.

Sediment is the largest single polluter of American waters. Its presence indicates erosion upstream and siltation downstream. Determining the sediment load of a stream or river is the first step toward finding causes and cures.

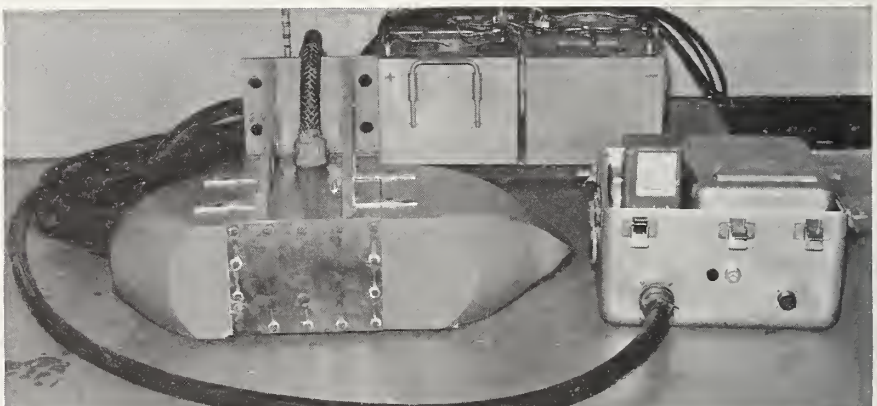
J. R. McHenry, soil scientist at the ARS Sedimentation Laboratory in Oxford, Miss., headed the gage testing project. A private company built the gage under sponsorship of the Atomic Energy Commission. It is one of several similar instruments being tested at the Sedimentation Laboratory.

In use, the gage is lowered into the stream. It sends a radioactive ray alternately through the stream water, then through a container of distilled water attached to the gage.

Sediment particles scatter and weaken the intensity of the radiation coming through the stream water. A sensing mechanism notes the extent of this weakening action, compares it to the force of the ray coming through the distilled water, and calculates the amount of sediment in the stream. The information is then relayed by cable to the recording apparatus on shore.

The gage contains a low-energy isotope—2 millicuries of cadmium 109. It gives off soft gamma rays that penetrate only a few inches of water and are not a threat to aquatic life, McHenry says.

Working with McHenry are geologist N. L. Coleman, hydraulic engineer J. C. Willis, agricultural engineer C. E. Murphree, mathematician G. C. Boltan, and chemist Angela Gill. Mississippi Agricultural Experiment Station and the University of Mississippi cooperated in the project.■

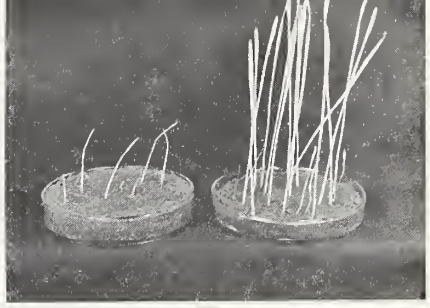


PN-1461

Left: Nuclear gage installed on Pigeon Roost Creek, north Mississippi. The detector unit with radioactive source is at the bottom of the pole held by the technician. The shore unit is just visible under the catwalk to the shore.

The detector unit (left) is lowered into the water and compares the intensity of a radioactive ray sent through stream water and through distilled water. Data is relayed by cable to the recording unit on shore (right).

With Crops on Stubble Mulch–Microbes May Cut Yields



PN–1462

Ground wheat straw added to the soil on the left stunted growth of wheat seedlings. Control soil on right had no straw added.

STUBBLE MULCHING, one of the best ways to control wind erosion in the Great Plains, sometimes reduces yields of subsequent crops. Why?

Possibly because of intense microbial activity in the surface inch of soil, says ARS microbiologist T. M. McCalla.

Stubble mulching, invaluable for halting wind erosion, is now practiced on thousands of acres of plains land. Although yield losses resulting from stubble mulching are relatively rare, the possibility of such loss sometimes discourages farmers from using the practice to advantage.

Working at Lincoln, Nebr., McCalla and ARS chemists W. D. Guenzi and F. A. Norstadt proved that many substances produced by microbes during decomposition of stubble are toxic to growing plants. The Nebraska Agricultural Experiment Station cooperated in the research.

In plowed soil, toxic substances are buried several inches beneath the surface. In stubble-mulched soil, they remain near the surface where they may come in contact with germinating seed.

Type of stubble, rate of decay, amount of rainfall, and many other factors affect the degree of toxicity in stubble mulch. McCalla found that wheat stubble collected immediately after harvest is almost always toxic to wheat seedlings, but wheat stubble that has lain on the field for 8 weeks after harvest contains no toxic material. Toxic material in corn and sorghum stubble, on the other hand, persists for some 22 to 28 weeks of decomposition.

The researchers collected stems and leaves of wheat, oats, corn, and sorghum stubble regularly over a period of 41 weeks after harvest. They made water extracts from the stubble and applied doses of the extracts to germinating seeds. The most toxic stubble was sorghum, followed by corn, oats and wheat.■

Fertilizer Washoff Slight With Heavy Rainfall

THE HEAVIEST "RAIN" of the century fell on Georgia recently, but little fertilizer washed off soil conservation test plots there.

In tests to determine whether runoff from fertilized fields contributes significantly to stream pollution, ARS soil scientist A. W. White applied 200 pounds of nitrogen fertilizer per acre to a fallowed plot. Then, he applied water to simulate rainfall at a rate that would occur naturally in the area only once every 100 years—5 inches in 2 hours.

The fallowed plot eroded badly during the simulated rainstorm, but only about 2 percent of the applied fertilizer washed away. Apparently, the first few minutes of rain moved much of the fertilizer downward into the soil where it was protected from erosion.

A plot covered with sod was subjected to the same test as the fallowed plot; less than 0.2 percent of the applied fertilizer washed off.

The work was done at the Southern Piedmont Conservation Research Center in Watkinsville, Ga. Working with White on the project were agricultural engineer A. P. Barnett and chemist W. A. Jackson, both of ARS, and chemist V. J. Kilmer, of the Tennessee Valley Authority. The Georgia Agricultural Experiment Station also cooperated.

Nitrogen and phosphorus, the prime ingredients in most commercial fertilizers, nourish the growth of algae in water. This growth reduces the oxygen content of water and leads to pollution.

However, nitrogen and phosphorus are released into waterways from a variety of sources. Up to a million tons of each chemical are discharged annually in the effluent from domestic sewers.

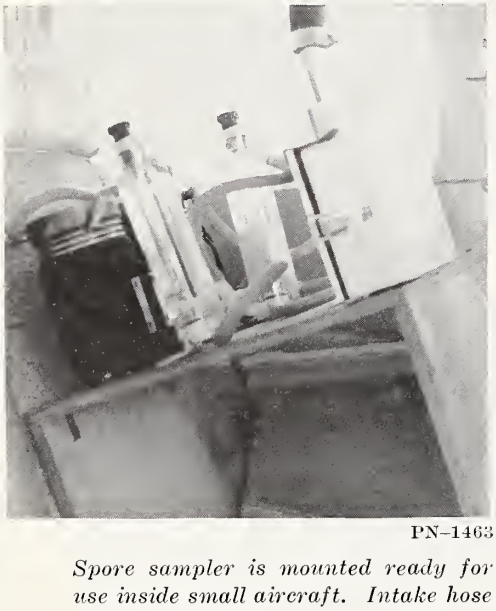
Farmers use about 4½ million tons of nitrogen per year. Washoff would have to exceed 20 percent of this total to equal the amount of nitrogen discharged by domestic sewers.

The Georgia researchers ran their study on sandy loam soil, sloped 5 percent, and used granular ammonium nitrate fertilizer. Water was turned on 1 hour after the fertilizer was applied.

Other conditions could produce higher rates of washoff, the researchers acknowledge. They will continue the experiments on a variety of slopes and soil types.■

Aerial Spore Sampler Determines

RUST INFECTION IN CEREAL CROPS



PN–1463

Spore sampler is mounted ready for use inside small aircraft. Intake hose is connected to the airplane's cabin air vent. Vacuum pumps and meters on left of sampler insure constant rate of air flow.

RESEARCHERS studying rust diseases of cereal crops have developed a sampling instrument, mounted in a small airplane, that continuously records populations of rust-causing fungus spores over long distances.

They have determined accurately the degree of rust infection in specific areas by counting the spores they trapped high above the fields.

Scientists may use the instrument in the future, to learn more about the nature of rust spores—how they survive in the atmosphere and how they move, sometimes for long distances, from infected areas to other grain-growing areas.

With this knowledge, it may be possible to predict rust epidemics before they occur, thus giving farmers enough advance notice to take preventive action at the best time (AGR. RES., March 1966, p. 15). Rust is a major problem in many areas where cereal grains are grown, and farmers now have no economical means of controlling epidemics after they start.

Researchers previously had used other aerial spore-sampling devices. Many of these were crude, however, and they could be used to collect spores only for short periods of time over limited areas.

The new sampler overcomes these problems. To provide a continuous record of spore populations over long distances, it collects spores on the surface of a slowly moving photographic film coated with an adhesive. From this record, scientists can later calculate the precise point in a flight where a given segment of the spore sample was collected.

Plant pathologists J. R. Burleigh of ARS and C. L. Kramer of the Kansas State University Experiment Station at Manhattan designed and built the sampler in collaboration with T. I. Collins of an electrical manufacturing firm.

In the instrument, an air pumping system that includes vacuum pumps, flow meter, and a constant-voltage supply delivers a fixed volume of air for sampling. A spring-wound clock motor which drives the film belt at one of three constant speeds insures that spores from the metered airflow are trapped at a given rate.

Spores are trapped on a 15-inch band of clear 35-millimeter photographic film coated with an adhesive. Depending on the rate the film travels, the band permits a maximum of 13 hours of continuous sampling.

After sampling, the scientists study the film under a microscope to determine the type and number of spores present. They use flight data, including altitude, airspeed, and areas flown over, to piece together patterns of spore dispersal.

The researchers tested their sampling instrument on two flights over midwestern wheat-growing areas—one of 581 miles from Manhattan to Rapid City, S. Dak.; the other of 608 miles from Manhattan to College Station, Tex.

On both flights they found that spores were numerous over areas that ground tests showed to be severely infected with rust. Over areas where infection was slight, or where wheat had been harvested, the researchers collected few spores.■

Device Measures Plant Growth

ARS agricultural engineers have developed an instrument that measures precisely how fast a plant grows—even in the dark.

Their motion detector measures and records movements of a plant during night or day with little or no disturbance to the plant itself.

H. H. Klueter and W. A. Bailey developed the instrument in cooperation with ARS' Crops Research Division at Beltsville, Md. In tests on pinto bean plants and zinnia seedlings, the instrument measured growth and movements as small as 0.0005 of an inch, or less than the thickness of a page of ordinary newspaper.

The growth and movements of plants have been measured and recorded for centuries. Perhaps the oldest record of plant growth is the annual growth rings of trees. Methods of measuring plant growth include photographing and using meter sticks, strings, or wire. With these methods, however, accuracy is often limited and the job is very tedious.

Developed to overcome these problems, the motion detector has 4 basic parts: (1) two electrical power supply units (transducers), one measuring horizontal growth; the other, vertical growth; (2) a unit for recording growth; (3) a rod that connects the unit to the plant; and (4) a platform that supports the connecting rod and transducers and rises automatically to correspond in height with the growing plant.

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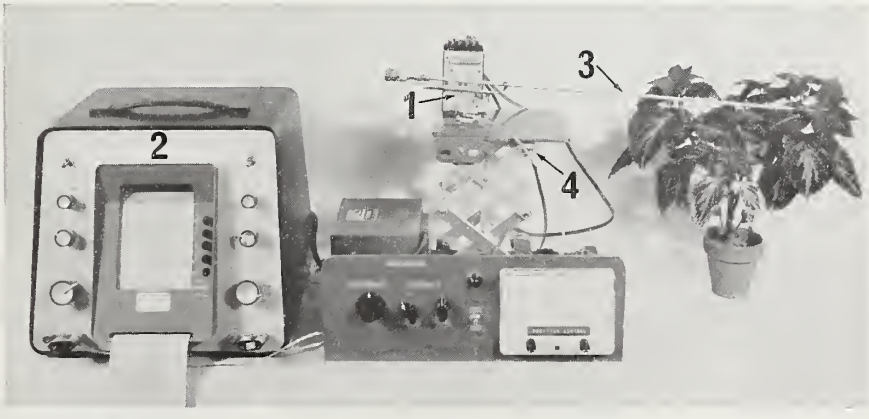

Parasites Killed Bighorn Sheep

Internal parasites were probably a major cause of the decline of Rocky Mountain bighorn sheep in North America, ARS parasitologist W. W. Becklund believes.

Before the white man came to North America, the bighorn probably ranged over all the mountainous areas of the West. Now, the wild sheep are found only in relatively isolated mountainous areas. This decline has been blamed on indiscriminate hunting, competition with domestic livestock for forage, and scabies. While Becklund believes these factors played a part in the decline, he considers internal parasites the major cause.

Becklund, working at Beltsville, Md., came to this conclusion after examining worm parasites isolated from Montana bighorn. Of the 51 different parasites he found in bighorn sheep, 36 are also found in domestic sheep and 18 are found in cattle.

This is not unexpected, the scientist says, because bighorn sheep compete with domestic livestock for forage. The bighorns graze foothill and mountainside pastures during winter months after cattle and sheep have grazed them during the summer.

Because many sheep parasites are transmitted as larvae on forage contaminated with droppings, Becklund points out, it is highly possible that the high death rate of bighorn sheep during the late 1800's was caused by internal parasites introduced to the area by domestic sheep and cattle.

New Yearbook—Protecting Our Food

Research and regulatory activities of ARS that insure and safeguard the quality of our food are highlighted in the latest Yearbook of Agriculture.

Recently published by USDA, the 1966 yearbook is entitled "Protecting Our Food."

In 416 pages and 105 photographs, the yearbook follows our food supply from the farmer's field to the homemaker's stove. It describes every stage in safeguarding that supply, including ARS' fight against insects, plant diseases and weeds; research in packaging, shipping, storing, and processing food; and regulatory work in plant quarantine, plant pest control, animal health, and pesticides regulation.

Our food abundance is one of the miracles of the age, but "didn't just happen," Secretary Orville L. Freeman points out in his foreword. "We have to fight 10,000 kinds of insects for our food. We have to combat

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1,500 plant diseases and 250 animal diseases. We have to fight spoilage and decay.

"The results of this battle to protect our food are evident. In our own country, food quality is high, the abundance great, and the cost relatively low. Overseas, we have supplied 98 percent of the food aid received by the less developed nations."

Copies of "Protecting Our Food" may be obtained for $2.50 each from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Replicator Aids Root Rot Research

A simple, homemade device called a replicator can compress a 50-day laboratory chore into 5.

It saves time and effort and allows microbiologists to study more organisms on a wider range of cultural media than was possible before.

The replicator was invented for use in the Forest Service research at Corvallis, Oreg., on root rots in the Douglas-fir. Root rots cause millions of dollars damage yearly to Douglas-fir in Oregon and Washington alone.

The replicator reduces the 10,000 test tubes of soil micro-organisms and other cultures used in the research to 400 plates and produces 25 cultures simultaneously.

FS microbiologists W. B. Bollen and K. C. Lu and mycologist J. M. Trappe, and Oregon State University microbiologist J. L. Neal, Jr., built the replicator for about $5 with parts commonly found around the home and laboratory. It has three main units—the press, the replicating unit, and the sliding platform.

The press, an old-fashioned bottle capper modified to fit a wooden frame, raises and lowers the replicating unit, a round piece of sheet metal cut to the size of a petri dish and set with 25 brass nails. The sliding platform carries two wooden stands. One stand holds test tubes of culture organisms; the other, a petri dish of a medium such as agar. Each stand can be moved under the replicating unit.

The brass nails of the replicating unit, lowered into the tubes by the press, pick up the culture organisms. The petri dish is then moved under the replicating unit which is again lowered to deposit the organisms into the medium on the petri dish, thus producing the 25 cultures simultaneously.

The metal replicator is sterilized each time the cultures are changed.

Blackhead in Treated Poultry

Some drugs kill cecal worms in poultry but let a protozoan parasite in the worms survive and cause blackhead disease in chickens and turkeys.

ARS parasitologist E. E. Lund says that birds treated for cecal worms with drugs that do not kill protozoa—phenothiazine, for example—have a greater incidence of blackhead than birds that received no treatment at all.

Blackhead, which once caused great losses to turkey growers, seldom is seen in poultry farms now. Most poultrymen treat their birds with drugs that kill cecal worms as well as antibiotics that kill protozoan parasites.

In tests at Beltsville, Md., Lund found that the destruction of cecal worms led to 100 percent infection of blackhead.

Chickens and turkeys get blackhead by eating earthworms infected with cecal worms. Lund inoculated a group of chickens with cecal worms and killed half the birds 10 days later. Cecal worms recovered from these birds were placed in young turkeys.

About half the worms died within 4 days. However, protozoa infection was evident a week after transfer. In another 5 days, the turkeys showed signs of blackhead.

Protozoa infection becomes evident about 6 days after it occurs. Therefore, Lund's tests show that the turkeys were being infected at about the time that many of the cecal worms were dying.

In birds with normally developing worms, the protozoa infection took place slowly over a period of several days, and only 80 percent of these birds became infected.

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